Proc. Roy. Soc (London), A, 241, 397 (1957)

33). To find the viscosity o
entation they will take u
that they will ultimatel
. This agress with Jeffery

grals, p. 4. Berlin: Springer

. 3, 533.
ke, 1, 383).

& Turnbull), 3, 79. New Yor

ykh Sred, p. 666. Moscow

y Press.

is: Carré et Naud.

rsity Press.

pl. Phys. 22, 1121.

13.

The effect of pressure on the electrical resistance of copper at low temperatures

By J. S. Dugdale and D. Gugan*

Division of Pure Physics, National Research Council, Ottawa, Canada

(*Communicated by N. F. Mott, F.R.S.—Received* 5 *March* 1957)

The resistivity of copper under hydrostatic pressures up to 3000 atm has been measured at temperatures between 4° K and room temperature. Two specimens of commercially pure copper (99·98 %) and an alloy of 0·056 at. % iron in copper were studied, the alloy being chosen because it showed a large resistance minimum.

The effect of pressure on the ideal resistivity is in good agreement with Grüneisen's theory. There were some theoretical reasons for expecting that the alloy would have a large pressure coefficient of resistivity at or below the temperature of the resistance minimum. The pressure coefficient at these temperatures was, however, quite small and similar in value to the pressure coefficients of residual resistivity of the two purer specimens.

Both the residual resistivity of the alloy and its pressure coefficient appeared to be strongly dependent on temperature.

1. Introduction

The electrical resistance of copper at low temperatures is of particular interest; quite small traces of certain impurities in copper cause the resistance of the specimen to increase with falling temperature instead of becoming constant as theory predicts. The actual temperature at which the minimum of resistance occurs depends on the kind of impurity and its concentration (MacDonald 1952; MacDonald & Pearson 1955); it usually lies between about 10 and 25° K. The rise in resistance below the minimum likewise depends on the kind and concentration of impurity, and in some cases the rise is comparatively large.

MacDonald & Pearson (1953, 1954) have shown that an unusually large thermoelectric power at low temperatures is associated with this strange resistive behaviour and have suggested that this effect would in turn be associated with an abnormally large pressure coefficient of resistance at low temperatures. Consequently, we have measured at very low temperatures the pressure coefficient of a dilute copper alloy showing a typical resistance minimum. Both for the sake of comparison and for its own intrinsic interest we have also measured the pressure coefficient at these temperatures of two quite pure samples of copper which did not exhibit the resistance minimum. The following is an account of these experiments and their results.

2. Experimental method

One difficulty inherent in all attempts to measure pressure effects at low temperatures is to find a suitable pressure-transmitting medium. Ideally, of course, we should like to have a true fluid of low viscosity, but this is not possible because all substances become solid under pressure at low enough temperatures. We have therefore chosen to use helium as the pressure medium because at a given pressure it retains its ideal fluid characteristics down to a lower temperature than any other

* National Research Laboratories Postdoctorate Fellow.